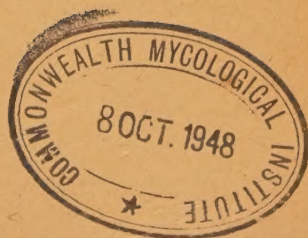


Report of the Work of The Rubber Research Board in 1947

(Established under the Rubber Research Ordinance Chapter 302)



June, 1948



Report of the Work of The Rubber Research Board in 1947.

The present report is the seventeenth Annual Report of the Rubber Research Scheme (Ceylon) as constituted under the Rubber Research Ordinance (Chapter 302).

CHAIRMAN'S REPORT

Board Membership.—The following changes in the membership of the Board occurred during the year :—

Mr. F. J. C. de Mel resigned and Mr. T. C. A. de Soysa was nominated in his place from 30th January.

Mr. F. H. Griffith, M.P., left the Island on leave and Mr. J. D. Farquharson was nominated to act for him from 15th February. Mr. Griffith resumed membership on 22nd August.

Mr. A. W. Harrison resigned and Mr. R. J. Hartley was nominated in his place from 14th March.

Mr. E. J. O. Richardson resigned and Col. J. T. Young was nominated in his place from 1st April.

Mr. C. A. C. Bowen left the Island on leave and Mr. A. D. Layton was nominated to act for him from 1st April. Mr. Bowen resumed membership on 27th November.

Mr. T. D. Perera, C.C.S., Deputy Secretary to the Treasury, was nominated to represent the Minister of Finance in place of Mr. H. E. Peries, C.C.S., from 23rd October.

Mr. D. Rhind assumed duties as Chairman of the Board on appointment as Director of Agriculture from 20th October.

Special mention was made of the valuable services rendered to the Board by Mr. L. J. de S. Seneviratne who had served as Chairman from 14th February, 1944.

The personnel of the Board at the end of 1947 was as follows :—

Ex-Officio Members :—

The Director of Agriculture — Mr. D. Rhind.

Representing the Minister of Finance — The Deputy Secretary to the Treasury (Mr. T. D. Perera, C.C.S.)

Unofficial Members of Parliament nominated by H. E. the Governor :—

The Hon'ble Mr. G. E. de Silva, M.P.

Mr. Simon Abeywickrema, M.P.
(Vacant).

Members nominated by the Ceylon Estates Proprietary Association :—

Mr. W. H. Attfield.

Col. J. T. Young.

Members nominated by the Planters' Association of Ceylon :—

Mr. F. H. Griffith, M.P.

Mr. R. C. L. Notley.

Members nominated by the Rubber-Growers' Association :—

Mr. C. A. C. Bowen.

Mr. R. J. Hartley.

Members nominated by the Low-Country Products Association of Ceylon :—

Mr. W. Neal de Alwis, J.P.

Mr. Noel de Silva.

Mr. A. M. Clement Dias.

Mr. T. C. A. de Soysa.

Members nominated by H. E. the Governor to represent smallholders :—

Mr. W. P. H. Dias, J.P.

Mr. F. A. Obeyesekere.

Meetings.—Meetings of the Board were held in Colombo on 8th April 12th May, 28th July, 3rd November and 15th December.

Committees :—

Experimental Committee — Mr. Thomas Amarasuriya acted for Mr. F. H. Griffith during the latter's absence on leave and Mr. R. C. L. Notley acted as Chairman of the Committee during this period.

The personnel of the Committee at the end of the year was as follows :—

Mr. F. H. Griffith, M.P. (Chairman).

Mr. W. P. H. Dias, J.P.

Mr. Noel de Silva.

Mr. R. C. L. Notley.

Mr. F. A. Obeyesekere.

The Director (Convener).

Meetings of the Committee were held on 8th April, 2nd May, 15th July and 2nd October.

Smallholdings Committee.—There were no changes in the membership of the Committee which, at the end of the year, was as follows :—

Mr. W. P. H. Dias, J.P.

Mr. F. A. Obeyesekere.

The Smallholdings Propaganda Officer.

The Director (Chairman and Convener).

A meeting of the Committee was held on 7th July. Members of the Board were also invited to attend this meeting and 9 members attended.

Ad-hoc Committees :—

Finance Committee.—A Committee consisting of the Chairman of the Board, the Director and the Treasury representative was appointed to consider the financial position of the Scheme and formulate proposals for continuing the work of the Scheme, stating the minimum staff and funds required for the purpose. The Committee met on 25th November and submitted a report which was considered by the Board at its meeting of 15th December.

Senior Staff Salaries Committee.—A Committee consisting of the Chairman, the Treasury representative and the Director was appointed to consider the question of revising the salaries and war allowances of the senior staff; also re-organisation of the staff if necessary. The Committee met on 22nd April and 12th May and its report was considered by the Board at its meeting of 12th May.

Junior Staff Salaries Committee.—A Committee consisting of Messrs. W. P. H. Dias, A. M. C. Dias, R. C. L. Notley and the Director was appointed to consider the salaries and terms of service of the junior staff. The Committee met on 15th April and its report was considered by the Board at its meeting of 12th May.

London Advisory Committee for Rubber Research (Ceylon and Malaya).—The Board contributed jointly with the Rubber Research Institute of Malaya to the cost of research on the quality and utilisation of raw rubber carried out at the Imperial Institute, London, under the control of the London Advisory Committee for Rubber Research (Ceylon and Malaya). Meetings of the Advisory Committee and of the Technical Sub-Committee were held on 7th February, 27th June and 7th November.

Future Development.—Following the recommendations made by the Finance Committee, a deputation consisting of the Chairman, the Director, and five members of the Board waited on the Minister of Agriculture and Lands with the request that the cess be increased to 50 cents per 100 lbs.

Administration.—Dr. E. Rhodes assumed duties as Director on 26th February

FINANCE.

Income.—The Board's main income was derived from the cess on exports of rubber under Section 6(1)a of the Rubber Research Ordinance. The increased cess rate of $\frac{1}{4}$ cent per lb. became operative in January; thus the income from this source exceeded the estimate for the year.

Monthly cess collections for the year were as follows:—

			B/forward	Rs. 174,963.97
January	...	Rs. 21,515.56	July	... „ 38,024.27
February	...	35,837.68	August	... „ 49,308.64
March	...	43,887.55	September	... „ 39,348.40
April	...	41,283.44	October	... „ 67,539.59
May	...	21,798.45	November	... „ 38,962.96
June	...	10,641.29	December	... „ 43,001.57
C/over	...	Rs. 174,963.97		Rs. 451,149.40

A loss of Rs. 4,433.80 was incurred on the normal working of Darton-field Estate and Rs. 2,622.22 on Nivitigalakele.

Expenditure.—Current expenditure, exclusive of losses on estate working accounts, amounted to Rs. 435,895.68. The surplus of income over expenditure was therefore Rs. 31,754.62.

Capital expenditure amounting to Rs. 118,450 was incurred mainly in respect of Agricultural Development Rs. 26,661; construction of Secretary-Accountant's bungalow, 1 junior staff bungalow, labourers' and attendants' cottages, and schoolmaster's quarters Rs. 66,155; alterations to experimental factory and laboratories Rs. 1,429; Hedigalla cart road Rs. 11,094; Furniture and equipment Rs. 6,186; Water and Power Supply Rs. 6,625; and Laboratory apparatus Rs. 300.

Accounts.—The accounts for the year, with a Balance Sheet showing the property and liabilities of the Board, have been prepared and submitted to the Auditor-General for examination.

Technical Reports.—The Director's report, which embodies the reports of the other officers, and the report of the London Advisory Committee for Rubber Research (Ceylon and Malaya) are attached.

(Sgd.) D. RHIND,

March, 1948,

Chairman of the Board,
Rubber Research Scheme (Ceylon).

DIRECTOR'S REPORT

The year has been one of uneasiness during which not only was it not possible to enlarge the research staff in accordance with the Board's intentions, but the loss of experienced officers commenced. It has been possible to maintain the field experimental programme in spite of the absence of the Botanist on leave for four months. The advisory service and routine work on the chemical side has also continued, although in the absence of the Chemist during the second half of the year the longer range research work was necessarily in abeyance. The outlook for 1948 borders on the desperate as there is a strong likelihood that the Director and the Botanist may be the only available research officers after the first quarter of the year.

The report includes a summary of the work of each Department.

STAFF.

Director.—Dr. Edgar Rhodes assumed duty at the end of February.

Chemical Department.—On the arrival of the Director, Mr. M. W. Philpott resumed full-time duty as Chemist until 6th June when he left the Island on long leave. Late in the year it was learnt with great regret that his services would no longer be available to the Scheme.

Botanical-Mycological Department.—Mr. C. G. Hansford, Mycologist, was on duty throughout the year, but it became known during October that he intended to leave the Scheme's service. (He left Ceylon during January, 1948).

Mr. C. A. de Silva Botanist, was on end of contract leave from 13th September until the end of the year. (He returned to duty on 14th January, 1948).

Soils Department.—Dr. L. A. Whelan, Soils Chemist, was on duty throughout the year.

Smallholdings Department.—Mr. W. I. Pieris, Smallholdings Propaganda Officer was on duty throughout the year and from 1st November he was assisted by Mr. H. H. Peiris who then assumed duty as Deputy Smallholdings Propaganda Officer.

Estate Department.—Mr. G. P. N. de Silva resigned from the office of Estate Superintendent on 30th September and Mr. L. Wijeyagoonewardene assumed duty as Assistant Estate Superintendent. The duties of Estate Superintendent proper were taken over by the Director.

Headquarters Office.—Mr. C. D. de Fonseka, Secretary-Accountant, returned from overseas leave on 28th February and was on duty during the remainder of the year.

Research Assistants.—These appointments were re-advertised during the year but no suitable men offered themselves. Personal enquiries and visits to the University have indicated that there is no likelihood of suitable men being available during 1948.

CHEMICAL DEPARTMENT

Research Work.

General.—The departure of Mr. Philpott on leave early in June and his subsequent resignation, coupled with the loss of the key trained assistants to more lucrative appointments, brought effective long range research to an end before the middle of the year and there is little prospect of re-commencement during 1948.

Control of Plasticity.—Further trials were made by Mr. Philpott to determine the effect of amines and nitro-compounds on plasticity and in these a slightly elevated temperature of 60°C was used. The dyes Bismarck Brown and Fuchsine which contain free NH_2 groups cause progressive stiffening. The m and p Phenylenediamines, which at room temperature induce stiffening behave somewhat differently at 60°C. and cause at first a progressive hardening followed by softening if the heating be prolonged. The o derivative accelerates the softening of rubber 60°C. Dinitrobenzene which produces a soft rubber at room temperature does not induce progressively more softening in rubber heated at 60°C. Because the most active stiffening agents so far found are aromatic amines containing two or more nuclear NH_2 groups, it was thought that diphenols might also induce stiffening but both hydroquinone and resorcinol were found to be inactive. Of two triphenols tested, pyrogallol was inactive while phloroglucinol was strongly active. There is ample evidence to show that the stiffening capacity of diamines diminishes with increasing acidity of the medium. Latex was coagulated with a range of acids of widely different dissociation constants and the order of increasing hardness of the rubber was the same as the order of decreasing dissociation constant of the coagulants used.

It would appear from the above facts that softening by nitro-compounds and hardening by amines are probably connected processes and that softening by nitro-compounds may not be due to accelerated oxidative breakdown.

It would also appear that the diamines are active only in the non-ionised form.

Mr. Philpott presented a paper on the control of plasticity to the 1947 International Congress of Pure and Applied Chemistry.

Rubber Seed Oil.

The prevailing world scarcity of vegetable oils and their high prices led to a re-consideration of the possibility of collection and marketing of rubber seeds. A circular was issued inviting estates to make experimental collections during the 1947 seed season with a view to determining the probable cost per ton under Ceylon estate conditions. At the same time two oil milling concerns agreed to make expression trials on a sufficiently large scale to determine the commercial possibility of local expression of oil. The seed season in 1947 was however a complete failure because of the most severe attack of *Phytophthora* pod disease for many years, and it was quite impossible therefore for reliable information on collection costs to be obtained. The two oil milling concerns did with some difficulty obtain sufficient seed for small scale trials which were in both cases disappointing particularly with regard to the percentage of free fatty acids which was unduly high indicating that in spite of the fact that the seeds were heated immediately on receipt by the oil millers, enzyme activity had been too great between seed fall and expression. These meagre results are sufficient to indicate however:—

- (i) that in Ceylon the total available amount of seed must always be expected to be very much less per acre than in Malaya where *Oidium* attack on the flowers and *Phytophthora* attack on the seed pods is almost negligible by comparison. The 1947 seed season has indicated that the Ceylon crop can in bad seasons be reduced to negligible proportions;
- (ii) that if oil of satisfactory commercial quality is to be obtained, lipolytic enzyme activity must be minimal which pre-supposes rapid collection and sterilisation of seed before extraction of oil commences. The terrain in Ceylon is hilly, extensive use is made of ground

covers and almost no estates have either the means of sterilisation, or are situated close to existing copra kilns which might be used for the purpose; seed may therefore lie for days before it is found and be virtually useless even before it is sterilised. The fact that although the Ceylon oil millers were already aware of these dangers and did their best to get their suppliers to avoid them, the quality of the oil obtained was sub-standard, gives rise to very serious doubt as to whether oil from wholesale collection of seed from Ceylon estates could ever be of consistently good commercial quality. The collection of seed on smallholdings could in certain circumstances offer perhaps more possibilities than the collection from estates. Such holdings are more frequently on flatter ground which is usually bare. Seed could be collected daily by the smallholders' children during the July-August seed season, but an elaborate depot organisation would be necessary to which the seed could be taken for sale and from which seed could be transported daily to sterilisation centres. The Rubber Commissioner's present depots and transport system could meet these requirements but until rubber seed oil from other sources has established itself on the world's markets at a known price it would not be possible for the Rubber Commissioner to consider extending the services of his depots for these purposes and arranging for sterilisation and final sale.

Special Rubber and Vulcanised Products

On behalf of the Department of Commerce and Industries a consignment of captax softened rubber was prepared for trial by a tyre manufacturer in U. S. A.

Although the manufacture of vulcanised articles no longer comes within the purview of the Scheme's activities, the manufacture of 1,000 seats and 1,000 pairs of arm rests in sponge rubber was undertaken and completed for the equipment of a cinema. No further work of this kind will be undertaken in the future.

Estate Manufacture.

Since early June it has been necessary for the Director to take over the day-to-day duties of advisory chemist.

In the early part of the year there was a serious shortage of sodium bisulphite which gave rise to many enquiries for substitute materials and for several months it was necessary for crepe producing estates to use sodium sulphite in abnormally large amounts in order to preserve a good colour. This naturally entailed the use of unusually large amounts of coagulant but until the supply position eased there was no alternative. In this connection and at this time Mr. Philpott made the interesting observation that if Captax (MBT) is added to latex in amounts equal to 1 part per 5,000-10,000 parts of rubber, discolouration of the coagulum is suppressed. Estates have so far not been recommended to adopt this procedure.

Two estates have erected creaming plants during the year and their rubber-makers have been trained in the manufacture and testing of creamed latex. Other estates have made preliminary trials. In all cases all possible advice has been given.

Meteorological Observations

The weather summary for 1947 is shown below and is based on data obtained for the Colombo Observatory :—

	1947	1946
Rainfall (ins.)	... 172.98	158.0
Highest monthly rainfall (ins.)	... 26.39 (October)	24.7 (Dec.)
Highest daily rainfall (ins.)	... 6.20 (20-21.10.47)	7.49 (28.4.46)
Highest shade temperature (day)	... 94.4°F (28.2.47)	94.2°F (11.3.46)
Lowest temperature (night)	... 62.5°F (10.2.47)	63.8°F (5.1.46)
Number of rainy days	... 225	244

BOTANICAL AND MYCOLOGICAL DEPARTMENT

C. G. Hansford.

C. A. de Silva.

Mycological.

The 1947 season in the low-country showed on the whole a rather mild attack of *Oidium*, though late wintering trees suffered at least one complete defoliation. The wintering season was delayed, owing to the heavy rainfall of the previous November and December, and the first signs of wintering on Dartonfield occurred in the first week of January, whereas the present wintering season has begun in early December. By the end of January, 1947 the first trees had commenced refoilation and on the 7th February, a few colonies of *Oidium* were found scattered at random over their leaves which had then reached the full green stage and were practically of mature size; the colonies were confined to the upper surfaces of the few leaves infected and in most instances only a single colony was present on a leaf. These leaves did not shed, but the *Oidium* remained on them producing abundant conidia for 3-4 weeks. During the remainder of February the fungus gradually became more prevalent, though mostly confined to leaves in the green stage of semi maturity and hence very little leaf shedding occurred. About 1st March the habit of the fungus suddenly changed and wholesale infection of bronze leaves occurred during the following week, with consequent severe leaf shedding during the next few days. These conditions continued for the remainder of March, after which the epidemic gradually died down except on the extremely late wintering clone PB. 6/9.

Fortunately during the 1947 refoilation season the bulk of the trees on most estates had passed the susceptible stage before the period of severe infection occurred, and hence the epidemic as a whole was less severe than on many occasions in the past.

The story of the 1947-48 wintering period cannot yet be written, but conditions are now almost the exact opposite of those prevailing last year. Instead of a record rainfall in November-December, we have experienced virtually a record drought, with the result that wintering of the rubber trees has been advanced about six weeks for most clones. Yet the story so far of the annual *Oidium* attack has been identical with that of the last season. The very first tree to re-foliate has shown a few scattered colonies (six in all) on its fully expanded green leaves, limited to their upper surface: these were discovered on December 16 and confirmed on December 18th.

No trace could then be found on neighbouring trees with somewhat younger leaves but until the end of the month there was a gradual spread of the fungus on to them, limited almost entirely to the upper surface of the leaves.

Thus in the low-country of Ceylon the *Oidium* epidemic commences each year as a few colonies on the very early wintering trees and spreads from them for about a month to the fairly mature green leaves of their successors to winter. Eventually the foliage of the latter becomes quite heavily attacked, but being past the extremely susceptible bronze stage it does not shed in any serious amount. Then for some reason still entirely unknown the fungus suddenly makes a large scale attack on younger bronze leaves, develops very rapidly on them and causes wholesale shedding within 5-6 days after infection. Some years this severe attack may be repeated once or twice, before the epidemic gradually dies down and the trees are able to form a permanent foliage for the year. In other years most trees suffer none or only a single defoliation. From this general picture of the *Oidium* epidemic in the Ceylon low-country arise a number of questions, and attempts have been made during 1947 to provide answers to some of them.

The first question is that of the persistence of *Oidium* in the low-country throughout the year. At Dartonfield there is a small area of a very late-wintering clone PB. 6/9, and in 1947 it suffered defoliation from *Oidium* repeatedly until mid-May, and it was not until towards the end of June that it was able to form a reasonably dense canopy. Even then some of its leaves bore active *Oidium* colonies up to early August. Unfortunately this year a severe epidemic of *Phytophthora* occurred in July-August so that normal conditions of foliage renewal were considerably upset. In September, after the leaf fall caused by this fungus there was an abnormal amount of young foliage present on the trees, and it was expected that *Oidium* would attack it. Close examination of many trees failed to reveal any sign of its presence, however, although a few colonies of *Oidium* had been found towards the end of July on a tree artificially defoliated on July 1st. This absence of *Oidium* on young foliage in September was very unexpected, especially as on October 1st two colonies were found on a 2-year-old seedling tree growing in a water-course reservation at Dartonfield. It is still possible that occasional colonies may have occurred on the September crop of new foliage, and were missed by the field glass examinations made. The Mycologist's opinion is that this possibility of very small scale existence of *Oidium* throughout the year in the low-country rubber plantations cannot be entirely ruled out, and would account for the few colonies appearing on the very early wintering trees each season.

The second point arising from the field study of the annual *Oidium* epidemic is the origin of the original colonies found each season. The old explanation was that the fungus was able to exist in some resting form in the buds of the trees, as is known to happen in the case of some nearly related mildews of temperate plants. Mere examination of the occurrence of the original colonies of the rubber mildew shows that there is no definite relation to buds. The colonies are few in number and may occur on single leaflets of the comparatively large number formed from one dormant bud; they are most often situated in the centre of the upper surface and never occur on the lower surface; and finally bear no relation to the stem of the twig on which they occur. It is concluded that they result from sporadic air-borne conidia of the fungus. This conclusion was tested by enclosing dormant branches in cellophane bags, and allowing the

badly to develop their foliage within the bags while protected from outside infection. Great trouble was found in rendering these cellophane bags capable of standing up to heavy rainstorms, but the trials were successful enough to indicate that no *Oidium* develops under such conditions. Even in the case of bags damaged, such infection as did occur was always on leaves exposed to the outer air through openings in the bags. It is possible however that the conditions of absolute saturation of moisture inside the bags would prevent development of *Oidium*, and this alternative explanation of the experimental results needs testing further. All that can now be said is that evidence hitherto indicates that the fungus is air-borne to the leaves of the trees first to winter in each season, and that having once infected these, the origin of the epidemic is thereby accounted for.

With regard to clonal resistance and susceptibility, we have as yet no evidence of any sufficiently high degree of resistance to be of commercial value amongst any clones at present in existence in Ceylon. One of the more promising kinds of resistance was shown in 1947 by HC. 28 — a late wintering clone which becomes quite heavily infected with *Oidium* but shows comparatively little leaf shedding. Further observations are needed on this matter, especially in view of the marked differences in behaviour shown by any individual clone when planted in different situations. This variability in reaction in *Oidium* also extends to the relative date of wintering of any clone in comparison with others close by, and is also shown from season to season. For instance in the 1946-47 season the first trees to winter and to refoliate at Dartonfield were those of R.R.I. 506, and the first signs of *Oidium* were found on one tree of this clone. In the 1947-48 season some trees of PB. 183 which had not recovered at all well from the *Phytophthora* leaf-fall in August-September, were first to winter, and one tree of this clone showed the first colonies of *Oidium* this season.

The conditions governing the sudden increase in severity of *Oidium* attack on young bronze leaves each year remain entirely undiscovered. Much time has been spent by the Mycologist in detailed examination of meteorological records dating back to 1935, and no correlation has yet been discovered to indicate that one or two meteorological factors control such development. Our present knowledge renders it impossible to give more than 4 or 5 days' warning, of an impending epidemic, and such a warning would be of use only on the individual estate under very detailed day to day observation. Hence it is not yet possible to give estates in general any useful forecast of when to commence dusting operations, or whether these can be dispensed with in any given season. If it became possible even to give 14 days' notice of danger of heavy attack then in years of light attack estates might be saved this expense. Present prospects are that such a long-term forecast will not become possible for some years to come.

The condition and yield figures of neighbouring estates may be taken as reflecting a general summary of conditions over the past 10 years, and in this matter a comparison between Dartonfield, dusted regularly each year, and Mukalana never dusted, shows that *Oidium* in this district has not been severe in its effects.

Conditions relating to *Oidium* on estates in the drier and more elevated districts of Matale and Kandy are altogether different from those in the low-country. The fungus exists in quantity throughout the year there on all trees having foliage in a susceptible condition. In these districts it is virtually impossible to obtain a reasonable density of foliage without the most careful and regular sulphur dusting possible.

Before leaving the subject of the epidemiology of *Oidium* it is necessary to correct a statement often repeated in the past, that the fungus is capable of infecting mature rubber leaves. No single case of such infection has been observed by the Mycologist, and all spots and deformations shown by mature rubber leaves as due to *Oidium* attack are merely the long-term results of infections occurring at the latest about 3 weeks after the buds open. After infection has once occurred the fungus is able to exist on the leaf in active and sporulating condition for 6-8 weeks at the most, when its mycelium gradually disintegrates and dies away. The only reasonably efficient control measure for a disease of this nature, affecting a comparatively large tree is that of sulphur dusting both to protect young foliage against infection and to control to some extent the development and sporulation of colonies already formed. There is some indication that present apparatus and sulphur dusts are not ideal, but with the limited facilities available to the Rubber Research Scheme it is not possible to make detailed investigations of these matters. Fortunately Imperial Chemical Industries have recently taken an interest and have promised to make trials of new dusts and machines in England, before sending them to us for field tests. From their resources we may hope to obtain results of practical value to rubber planters in a much shorter time than would otherwise be possible.

The essential of control of *Oidium* in a district liable to severe and regular annual attack is very careful supervision and frequent repetition of small doses. Unfortunately the districts concerned are those in which the crop is least profitable, and hence the recent Rubber Commission has recommended that rubber is no longer a practicable crop there.

The rubber estates of the low-country districts of Ceylon suffered an exceptionally severe epidemic of *Phytophthora* leaf-fall in August-September 1947, probably the worst outbreak for about twenty years. Reports and inspections showed that no individual clone possessed everywhere any marked resistance to the attack, though a few clones such as BD. 5 proved particularly susceptible on almost all estates. The other standard clones such as TJ. 1 and PB. 86 on most estates showed moderate attack, but somewhere or other each clone suffered severely. Following the actual leaf fall due to the attack outbreaks of various forms of bark rot and canker on branches and main stems occurred, though in the case of these forms of *Phytophthora* attack the standard clones TJ. 1, PB. 86, HC. 28 and GL. 1 did not suffer to the same extent as some others including BD. 5 and PB. 183. All low-country estates were advised of the dangers consequent upon this severe attack of *Phytophthora* and special precautions must be continued at least until the end of 1948 to ensure that all canker and bark rot patches are thoroughly cleaned up and healed. With the present economic situation of the Ceylon rubber industry, it is manifestly completely impossible to attempt to prevent *Phytophthora* leaf-fall, but it is important to clean up annually all patches of stem and branch attack of this fungus.

The question of root disease, almost entirely due to *Fomes lignosus*, in replanted areas is coming very much to the fore in view of the heavy replanting programmes now under way. There appears to be much more danger of damage from this disease in replanted areas than in rubber planted on virgin land, probably due entirely to the presence of the susceptible roots of the old rubber in the soil. Present experience leads to the view that in many fields of old rubber in Ceylon there exist frequent incipient or quiescent foci of *Fomes* root disease, though the old trees do not show any symptoms. When the rubber is felled and replanted, the first sign of

the presence of *Fomes* is the death of a proportion of the young plants usually about 9-12 months after planting. Their roots show the typical mycelial strands of the fungus, which cannot be mistaken. Although it may not prove possible completely to prevent such attack in young replanted fields, there are a few precautions which can be adopted to minimise the danger. At the time of felling the old rubber, the main roots exposed by felling should be examined immediately for signs of *Fomes*; a few hours' delay may obscure all signs. Infected or doubtful trees should be marked and later their root systems further exposed for detailed examination. Where the fungus is found, all infected roots should be carefully dug up and burnt, as completely as possible, before replanting is commenced. Where the old stand has been poisoned with arsenite, this precaution is not possible. The bases of the old trees after felling are best left *in situ*, as we have found at Dartonfield that they form useful indicators of *Fomes*. If they have been attacked by this fungus, its fructifications soon appear on the rotting wood, instead of the normal crop of other harmless wood rotting fungi, and then all roots belonging to the infected stump and its immediate neighbours of the old stand should be opened up and infected material burnt. If the *Fomes* patches are not so treated immediately they are noticed, there is danger that the mycelium may spread rather extensively along the dying root systems of the old stand, and hence infect a much larger area than would otherwise be the case. The disease is capable of causing considerable damage in young replanted fields, especially now that our modern fields contain a much closer stand of plants, and it should prove well worthwhile to take steps to control it at the earliest possible stage, before the infection has become widespread and expensive to treat properly.

Planting Material.

Studies of Clones and Seedling Families.—3,046 trees were test-tapped at Nivitigalakele and Dartonfield consisting of local and foreign clones and clonal seedlings. The more important results are detailed under:—

Prang Besar Isolated Gardens and Tjikadoe Seed.—This seed was imported from Malaya and the Netherlands East Indies and planted in two clearings in 1932 and 1935. The trees have been test-tapped on S/2, 4/2, 100% system from 8 to 10 years up to October, 1947 when both areas were put under general commercial tapping. The test-tapping yields for the final year are given in Table I together with the yields of 3-tree PBS clones from selected mother trees of Plot C Prang Besar seedlings.

The Tjikadoe seedlings selected on vigour of growth have done better than those selected on test-pricking. The yields of the PBS. clones are very promising and 6 of these clones which have been planted in a large scale clone trial have given an average of 15 lbs. per tree per year of 130 tappings for 1947-48 in the seventh tapping year. Incidentally these buddings which are planted in a more favourable area of the 1935 clearing have grown better than most of the seedlings. The incidence of Brown Bast disease has been quite marked in the seedlings and in general it is found that seedlings are as susceptible to the disease as buddings.

New Trials.—A large scale trial for comparing clonal seed against buddings was completed at Dartonfield. 3 families of illegitimate seedlings of clones TJ. 1, PB. 86 and PB. 5/139 and a collection of hand pollinated seedling families representing a hypothetical seed garden were included for trial with clone TJ. 1 as the budded material. 36 tree plots were used for each of the 5 selections of planting material replicated 8 times, the area being planted at a density of 256 trees per acre. Thinning out will be carried out when the plants are 12 inches in girth on vigour of

TABLE I

Material	Planted as stumps	Year of tapping	No. of trees tapped	Mean yield in lbs. per tapping year per tree	Mean girth in ins. 1947	Brown Bast cases
Tjikadoe Isolated Garden Seedlings selected by test- pricking	1932	10	154	5.9	—	44
Tjikadoe Isolated Garden Seedlings selected for vigo- rous growth	1935	9	103	9.0	37.0	47
Prang Besar I. G. Seedlings, Plot B	1935	8	123	9.9	34.6	48
Prang Besar I. G. Seedlings, Plot C	1935	8	56	6.3	32.5	7
PBS clones, Plot C	1935	7	54	13.0	36.1	6

growth, yield, and secondary characters and permanent tapping will commence on the selected trees at a density of 160 trees per acre. The experiment should give valuable information on the potentialities of clonal seed compared with the best yielding clone TJ. 1 under the conditions laid down for the planting of clonal seed.

Hand-pollinated seed from the 1944 and 1945 seasons totalling about 5,000 seedlings and 1,355 derived clones in 5 tree plots were planted at the Hedigalla sub-station and on 9 outside estates during the year under review.

No. 3 Replanting Experiment, Dartonfield 1936.—The experiment provides for a comparison between 3 methods of establishing budgrafts in the field. Girth measurements were taken in June 1946 and 1947. The figures are summarised in Table II together with the yields for 1947. The stumped buddings were first tapped in March, 1942, the budded stumps in December, 1942 and the field buddings in December, 1943. The excess of yields of both stumped buddings and budded stumps over field buddings still persists in the 5th year of tapping.

The Botanical Department supervised the commercial tapping in this area for the second six months of 1947 to study the relationship in yield records taken from one sample tapping per month and yields obtained from the general estate from commercial tapping. The yield per tree per tapping in grams of dry rubber from test-tapping and commercial tapping were 24.1 and 21.2, respectively.

TABLE II

Material	Age June 1947 in years	Mean Girth in Inches			Yield per tree per tapping in gms. 1947
		1946	1947	Increase 1946/47	
Stumped buddings	11	28.29	29.74	1.45	24.5
Budded stumps	11	27.33	29.22	1.89	23.2
Budded in field	10 $\frac{3}{4}$	24.21	26.13	1.92	17.5
Sign. diff. (.01)		1.44	1.47		

This preliminary investigation shows that the method of test tapping is a reliable guide if allowance is made for the fact that test-tapping is carried out on normal tapping days only, while the estate shows records of tapping under all conditions of weather. The investigation is being continued.

Stock Experiment, Dartonfield 1941.—In this experiment 5 clones of "R.R.I. 500 Series" were budded on 5 illegitimate seedling family stocks and on unselected seedlings. The budgrafts were planted in June 1941. Each monoclonal block was made up of 16 sub-blocks each sub-block consisting of 6 single budded tree plots of the various stocks replicated sixteenfold. Unbudded seedlings of the various stocks were planted in 6 tree sub-plots replicated sixteenfold as in the budded areas.

Girth measurements were taken in May and a summary of results is given in Table III. As in previous years the differential effect of stocks on growth of scion is not of any practical importance. The best growth of unbudded seedling stocks is to be found in the AV. 163 family.

TABLE III
Mean Girth in Inches

Stock Family	TJ. 1	AV. 163	BD. 10	BS. 3	MK. 1/1	Un- selected	Sign. diff (.01)
Scion growth	16.5	17.3	16.6	17.0	16.9	16.9	Not sign.
Unbudded Seedling Families	20.3	22.2	20.5	19.8	19.8	19.0	2.4

Stem and Branch Budding Experiment — Hedigalla 1944.—This experiment was designed to test the differences in performance of buds taken from different parts of the same parent plant classified into 'stem' and 'branch' buddings. Budded plants established from the various types of buds were planted in a split-plot design using 10 clones, 3 types of budwood with 5 replications. The analyses of the girth measurements after 3 years' growth showed no significant differences between the various types of buds used.

New Clones from Tjikadoe Seedlings and Estate Mother Trees.—Field No. 6A, 1939 Clearing, Nivitigalakele.—44 clones planted in this area are made up of clones established from high yielding Tjikadoe seedlings, estate mother trees, marcots and controls of the better known local and foreign clones planted on a large scale. The layout consists of 20 polyclone blocks of 44 single tree plots representing the 44 clones. Tapping commenced in 1946 and the mean yields based on two sample tappings per month of the more promising clones compared with controls are given in Table IV,

TABLE IV

Yield of New Clones, Field 6A, 1939 Clearing, Nivitigalakele.
Tapping System S/2, d/2, 100%, 2 Sample Tappings per Month

Clones	No. of trees tapped	No. of cases B.B.	Yield in lbs. per tree per annum. 140 tappings			Mean girth in inches Sept. 1947
			1945/46	1946/47	1947/48	
*NAB. 17	12.19.20	—	5.1	7.9	12.2	25.1
*NAB. 16	8.18.20	—	5.1	6.6	9.4	22.7
*NAB. 15	9.20.20	—	4.4	6.8	11.6	26.0
*RR. 19	2.16.18	1	4.3	4.5	5.3	22.1
RR. 15	7.17.18	—	3.8	4.5	5.7	21.9
*NAB. 20	11.20.20	—	3.4	6.3	10.2	25.8
NAB. 21	6.19.14	5	2.9	4.3	6.4	23.4
†NAB. 12	9.19.18	—	3.0	5.0	8.5	25.3
†NAB. 8	8.18.18	—	2.9	4.5	7.9	25.1
NAB. 3	5.18.17	3	2.9	4.1	6.0	21.5
NAB. 11	11.20.20	—	2.7	4.8	7.2	24.5
NAB. 1	10.20.20	—	2.3	4.0	5.9	26.7
NAB. 19	10.20.19	1	2.2	3.5	5.3	29.9
NAB. 4	8.20.20	—	2.1	3.7	5.3	25.2
NAB. 5	8.19.19	—	2.0	3.8	5.4	24.1
NAB. 22	10.20.20	—	1.9	3.4	6.0	27.8
NAB. 2	10.18.19	—	1.9	3.7	5.3	27.1
NAB. 18	10.19.19	—	1.5	3.1	5.3	25.2
Controls						
TJ. 1	7.17.19	1	2.6	4.7	5.9	23.3
PB. 86	9.20.20	—	3.9	6.1	8.4	21.5
GL. 1	2.19.20	—	4.0	4.8	7.0	21.7
MK. 3/2	11.20.18	2	2.1	4.0	5.7	24.9
Significant difference (·05)				1.2	1.5	

* Clones selected for large-scale trial. † to be included later.

NOTE—Under the heading "No. of trees tapped" the figures indicate the number of trees tapped each year.

together with figures for growth and incidence of disease. 4 NAB. clones Nos. 15, 16, 17, 20 and RR. 19 have been selected for a large scale clone trial in 1950. It will be noted that the control clones under polyclone

TABLE V
Trial of Foreign Clones, Field 6B, 1940 Clearing, Nivitigalakele.
Tapping System S/2, d/2, 100%

Clone	No. of trees tapped	Yield in lbs. per tree per annum, 140 tappings 1947	Mean girth in inches, January '48
NAB. 26	24	6.4	22.6
RRIM. 511	21—23	5.9	20.6
PB. 6/50	23	5.9	24.9
RRIM. 513	22—24	5.8	20.2
RRIM. 500	19—21	5.6	21.2
AV. 255	24	5.6	24.1
RRIM. 501	20—22	5.4	19.5
RRIM. 504	19—22	5.1	20.1
<i>GL. 1</i>	<i>13—17</i>	<i>5.1</i>	<i>19.7</i>
RRIM. 506	19—20	5.1	20.2
RRIM. 514	14—23	4.9	18.7
PR. 107	22	4.7	21.2
PR. 106	21—22	4.5	21.1
RRIM. 519	17—21	4.5	19.5
PB. 5/57	20—22	4.4	21.1
<i>HC. 28</i>	<i>23</i>	<i>4.3</i>	<i>25.0</i>
Waringiana 4	23	4.2	21.7
PR. 105	16—22	4.2	19.9
BD. 17	20—21	4.1	19.9
B. 6	21—23	4.0	21.2
B. 7	14—20	4.0	19.8
NAB. 24	22—23	4.0	21.5
B. 1	24	3.9	23.3
<i>WG. 6278</i>	<i>22</i>	<i>3.9</i>	<i>20.5</i>
<i>TJ. 1</i>	<i>22—23</i>	<i>3.8</i>	<i>22.6</i>
Lunderston N	22	3.8	20.7
Pilmoor B. 84	23	3.5	21.4
Kali Djeroek 1	20—21	3.5	20.3
B. 13	24	3.3	21.9
B. 3	12—18	3.2	19.3
RRIM. 518	19—21	3.1	19.2
Parawatte 1	15—19	3.0	19.7
MK. 1/3	18—22	2.8	21.5
NAB. 25	22	2.8	22.0
AV. 352	23	2.6	22.5
Pilmoor D. 65	11—18	2.4	18.7

NOTE—Control clones are italicised.

conditions are not up to the standard of growth of some of the new clones. The yield of clone PB. 86 is reassuring.

Trial of Foreign Clones, Field 6B, 1940 Clearing, Nivitigalakele.—The experiment was primarily intended to test foreign clones of promise under local conditions. A few local clones and controls were included to make up a total of 36 clones. The experimental layout is a quasifactorial lattice design adopted with 2 replications of 3 arrangements each. Plots consist of 4 trees and total number of trees tested is 24. The trees were taken into tapping in 1947. The yield figures have not been analysed statistically as the full number of trees in the various clones have not come into tapping. Yield and growth figures are summarised in Table V. It would be premature to comment strictly on these early yields but there are indications of good results from a number of clones on trial in this area, under the conditions of the experiment.

Tapping Experiments.

Mature Seedling Rubber, Dartonfield 1937.—The 10th and final year of this experiment was completed in February, 1947. The yields for the year 1946-47 and for the 10 year period were summarised in the Combined 1st and 2nd Quarterly Circulars for 1947. The double-three system gave an increased yield of 19 per cent over the control up to the 7th year. In the 8th, 9th and 10th years there were signs of an apparent deterioration in yield. This was attributed to the tapping of somewhat immature bark, resulting from the high consumption of bark on this system on old seedling trees. The dry rubber content figures up to the end of the 10th year were quite satisfactory. Compared with the double-four system the cost of tapping on double-three was 15 per cent higher based on yield and tapping task, other conditions being equal.

Tapping Experiment No. 14 (Ladder Tapping) Dartonfield 1944.—This experiment was started on old seedling rubber in August 1944. The double-three system is compared with (a) double-three plus a half circumference V cut at 8 feet from ground level tapped downwards with the aid of a ladder and (b) double-three plus half V cut opened on virgin bark and tapped upwards. In March, 1946 the tapping system was changed from double-three to double-four and the comparisons were carried on as before. A summary of the yields as a percentage of the control 2S/2, d/3, 133% or 2S/2, d/4, 100% are given in Table VI.

TABLE VI

Period	S/2+V/2 (Ladder) d/3, 200%*			S/2, V/2 (Upward) d/3, 200%*			Sign. diff. % (.01)
	Lower cuts	Upper cuts	Total	Lower cuts	Upper cuts	Total	
Aug. 1944 to July 1945	87	56	143	80	56	136	17.4
Aug. 1945 to July 1946	87	60	147	73	55	128	28.8
Aug. 1946 to July 1947	86	63	149	77	51	128	22.5

* Changed March, 1946 to d/4, 150%

TABLE VII.
Tapping Experiment No. 5, Budded Rubber
Mean yield in pounds dry rubber per tree per annum and as per cent of S/2, d/2, 100%

Clone	Original Tapping System	1941-42	1942-43	1943-44	1944-45	1945-46	1946-47	New B.B. cases 1946 to 1947	Total cases 1942-1947	No. of trees wind-damaged
GL. 1	S/2, d/2, 100%	5.47 100%	6.57 100%	8.26 100%	4.28*	10.08	9.45	—	45	1
	S/3, d/2, 67%	4.44 81%	5.37 82%	6.94 83%	9.29	9.57	8.90	5	29	
	S/2, d/3, 67%	4.07 74%	6.02 92%	8.33 101%	5.80	12.31	9.90	2	25	
	2S/2, d/4, 100%	5.07 93%	6.30 96%	10.18 123%	5.14**	5.22	5.49	—	30	
AV. 256	S/2, d/2, 100%	3.13 100%	4.39 100%	5.37 100%	5.25 100%	5.68 100%	6.90 100%		8	
	S/3, d/2, 67%	2.40 77%	3.39 77%	4.22 79%	4.20 80%	4.45 78%	5.75 83%		2	
	S/2, d/3, 67%	2.24 72%	3.26 74%	8.93 166%	6.23 119%	7.97 140%	9.15 133%	1	17	
	2S/2, d/4, 100%	3.39 108%	4.96 113%	6.73 125%	5.31 101%	6.70 118%	7.79 113%		12	
PB. 25	S/2, d/2, 100%	3.70 100%	5.56 100%	6.30 100%	4.97 100%	7.60 100%	9.71 100%	1	13	11
	S/3, d/2, 67%	2.75 75%	4.28 77%	4.69 74%	4.45 90%	5.21 69%	6.81 70%	1	7	13
	S/2, d/3, 67%	2.66 72%	4.12 74%	10.26 163%	7.65 154%	9.54 127%	12.67 130%	2	13	16
	2S/2, d/4, 100%	3.50 75%	6.00 108%	7.61 121%	5.95 120%	7.65 102%	11.88 122%	2	10	13
Mean No. of tappings on		125	138	150	134	140	129			

† Changed to 2S/2 d/3, 133%, March, 1943

* " " S/4, d/2, 50%, September, 1944.

** " " S/2, d/4, 50%, September, 1944.

Significant increased yields were obtained over the control without a high incidence of dry cuts. The extra upward cut is the more practical and could be introduced as a third cut on old seedling rubber within 5 years of replanting ending up with slaughter tapping in the last 2 years.

Tapping Experiment No. 5, Budded Rubber, Dartonfield, Clone GL. 1, AV. 256 and PB. 25.—The trees in this area were planted in 1934. The experiment provides for the comparison of 4 tapping systems replicated 64 times in each of the three monoclonal blocks. The yields in pounds per tree per annum are given for the first 6 years in Table VII, together with the information on the incidence of Brown Bast. The reduction of tapping intensity, to 50 per cent has effectively reduced the high incidence of Brown Bast in clone GL. 1 during the first three years of tapping on 100 per cent intensity. The yield of 9.9 pounds per tree per annum on S/2, d/3, 67% indicates that the clone can be tapped on the reduced intensity permanently with very satisfactory returns in crop. Clones AV. 256 and PB. 25 which are now classed as second rate clones in Ceylon have given excellent yields on the double-three at 133% intensity introduced from the third year of tapping. The incidence of Brown Bast has been negligible.

It is interesting to note that the increased yields of double-four compared with the alternate day half-spiral system are of a higher order than those which can be expected from mature seedling rubber.

Future Programme.

Details of the proposed programme of experiments for all three estates for the period 1948 to 1954 were drawn up, together with a plan showing the various estate and nursery operations, staff changes and buildings to be erected year by year to implement the programme. This programme has necessitated much research into designs of experiments adapted to the special conditions of these estates to ensure that the utmost possible use is made of both the land available and of the experimental material, while keeping the expenditure down to a minimum. A range of suitable designs has now been completed and filed, together with specimen calculations required for their statistical analysis. In dealing with a permanent crop such as rubber where experimental material has to remain for at least 20 years it is vitally important that the best possible and the most efficient designs be utilised for all experiments, and also that the most rigid selection of material for planting be exercised, so as to avoid all possible loss of crop in the future. Consequently the time spent in considering alternative designs and adapting them to our very special conditions is likely to be repaid many times over in the future.

SOILS DEPARTMENT

L. A. Whelan.

Fertiliser Rationing.

The basis of the rationing scheme was essentially the same as in previous years :—

- (A) Mature Rubber (over 7 years old). A maximum allowance for the year of 145 lbs. ammonium sulphate per acre or 200 lbs. of the mixture: sulphate of ammonia 145, saphos phosphate 45, and muriate of potash 10.

- (B) Immature Rubber (up to 7 years old). Saphos phosphate for normal trees and an NPK mixture for backward trees. Quotas were based on the R. R. S. general recommendations with the restriction that the NPK mixture was not supplied for more than half the total acreage of young Rubber, except in the case of young Rubber in tapping.

Most estates preferred the mixtures to the single fertilisers for both young and old Rubber. The fertiliser requirements estimated under the rationing scheme for Rubber for the period July, 1947-June, 1948 were 18,000 tons ammonium sulphate, 7,300 tons saphos (rock) phosphate and 1,100 tons muriate of potash. Owing to the shortage of nitrogenous fertilizers in the Island in 1947, the issue of fertilizer for mature Rubber was only 75 per cent of the year's quota. The full quota was issued for young Rubber. Organic manures were decontrolled towards the end of the year and were obtainable without permit in addition to quotas issued under the rationing scheme. Phosphate and potash in excess of the quantities required for standard rationed mixtures were also released without permit.

During the year 169 late returns were attended to for the 1947 issue and 674 for the 1948 issue.

Experiment on Manuring of Mature Rubber, Dartonfield 1936.

Tapping was on the double-four system (100%) throughout the year. The mean yields for the year in kilograms of dry rubber per plot of 20 trees on the basis of one experimental tapping per month were:—

	O	N	NP	NK	NPK	Mean
Actual yield ...	5.56	7.03	6.62	6.92	8.19	6.86
Adjusted yield* ...	6.13	6.99	6.68	6.67	7.85	6.86
Adjusted yield 1947		114	109	109	128	
as percentage 1946		124	109	119	128	6.21
of control 1945		118	106	109	116	5.48
*Standard error				.295		
Significant difference odds		(19:1)		.86		
		(99:1)		1.15		

(On the basis of 90 trees per acre and 70 tappings per year the figures for adjusted yields given above may be converted to pounds per acre by multiplying by 58).

Significant responses were shown to the N and NPK treatments. The yield from the "complete" NPK mixture was significantly greater than that from either of the mixtures NP or NK. The increase in response to NPK for the year 1946 (see percentage figures in table above) were maintained in 1947 but the increased response to N dropped back in 1947 to its former level. For the first 10 years of the experiment it appeared as if nitrogen alone gave the most economical return but the 1947 yields indicate that an NPK programme may prove the more valuable when the renewed bark comes into tapping.

The average girth increment for the year was 0.5 inch. Differences between treatments were not significant.

A summary of the bark renewal in millimetres for the year is given below :—

	O	N	NP	NK	NPK
	6.5	6.7	6.9	6.6	7.1
Increase over control		0.2	0.4	0.1	0.6
Standard error					.104
Significant difference		Odds 19:1 99:1		0.3 0.4	

Treatments NP and NPK are significantly greater than the control. Although the differences are small and probably of little practical importance there is an indication that phosphate may be of value in bark renewal.

Experiments on Manuring of Budded Rubber

No. 2 Manuring Experiment, Dartonfield 1938.—Girth measurements at 4 feet above the union were taken in June 1947 and showed a mean increment of 2 inches for the year. Differences between treatments were small and not significant. The reduction in the annual girth increment from the previous figure of about 3 inches applies both to trees in tapping and to trees not in tapping and may be a result of the growth stage now reached. In the potash plots 82 per cent of the trees are now in tapping. In the other eight treatments the percentage of trees in tapping varies from 94 to 99.

During the year about 4 per cent of the trees were treated for brown bast and about 13 per cent for canker. There was no indication of any relationship between the various fertiliser treatments and the incidence of disease. All the plots of clone PB. 183 suffered very severely from an attack of *Phytophthora* in the third quarter of the year.

Trees were tapped throughout the year on the alternate day half-spiral (100%) system and yield figures were obtained from the 16 tree plots by means of one sample tapping per month. Tree scrap has been included.

Grams of Dry Rubber per Tree per Tapping

O	N	P	K	NP	NK	PK	NPK	Compost
21	20	24	18	23	21	21	21	21

The actual plot yields have been converted to pounds per acre on the basis of 105 trees per acre and 145 tappings per year. Yields have been similarly calculated for the period 1944-47. (Suitable trees were first taken into tapping in March, 1944 and new trees were added at 6 monthly intervals thereafter).

Pounds of Dry Rubber per Acre

	O	N	P	K	NP	NK	PK	NPK	Compost
1947	672	637	758	447	750	658	704	704	652
1944-47	1236	1096	1661	1039	1842	1395	1741	1748	1595

A comparison between the control and the mean of the manured plots shows a considerable response to fertilisers over the whole four-year period but very little response in 1947 indicating that the main benefit derived so far from manuring has been the bringing of the trees into earlier tapping.

No. 15 Manuring Experiment (Phosphate placement), Hedigalla 1943. Girth measurements taken at 3 feet above the union 4 1/2 years after planting budded stumps showed no difference between dibbling in superphosphate round the trees and concentrating it in 3 oz. balls below the soil surface. When saphos rock phosphate was used dibbling gave significantly better results than the placement method. A summary of the measurements in inches is given below:—

	Superphosphate		Rock Phosphate	
	Concentrated	Distributed	Concentrated	Distributed
	13.14	13.66	11.65	13.43
Significant difference	—		(Odds 99:1)	1.40

No. 16 Manuring Experiment (Phosphate level), Hedigalla 1944.— Girth measurements were taken at 3 feet, 3½ years after planting budded stumps and a summary is given below. The figures in the top row refer to the total amount of rock phosphate in ounces applied up to the time of taking measurements.

Phosphate level	Nil	21	42	63
Girth in inches	8.29	9.45	9.66	10.04
Standard error			.114	
Significant difference:				
Odds 19:1			.33	
Odds 99:1			.45	

All treatment results are significantly greater than the control. The highest level of application has given a response significantly greater than those given by the lower levels.

Rubber Seed.

In response to a request from England for rubber seed for experimental purposes seed was purchased from an estate in Monaragala district in November, treated in the Dartonfield factory and 2 cwt. of the dried decorticated seed forwarded to the enquirer.

Laboratory Work.

A number of samples of compost and proprietary organic manures were sent in for examination during the year. These were generally satisfactory but the importance of the cost of material, transport and application in comparison with chemical fertilisers was pointed out.

Since the departure of the Chemist in June the examination of samples of acid and bisulphite sent in by estates has been carried out by the department.

SMALLHOLDINGS DEPARTMENT

W. I. Peiris.

Administration.

The increase in the number of Range Rubber Instructors from seven to ten in October 1946 resulted in a considerable increase both in administrative and supervisory duties during 1947, until in November 1947 Mr. H. H. Peiris was appointed as Deputy Smallholdings Propaganda Officer and an Assistant Clerk was appointed to the office. With the appointment of Mr. Peiris it became possible to give closer and more frequent supervision

to the work carried out by the 10 Instructors in their respective ranges. Mr. Peiris assumed duties on November 1st and the Assistant Clerk, Mr. R. A. Somadasa, on November 17th.

There were a number of changes in the staff during the year. Among these the loss (in November) of Mr. A. A. Silva, Clerk-Translator, was keenly felt. Mr. D. P. A. F. Abeyewardene was appointed to the vacancy thus created and he assumed duties on November 11th. Mr. H. P. G. Pieris, Rubber Instructor, Kandy, who was one of the most senior Instructors, resigned in February and was replaced by Mr. N. D. A. W. Seneviratne, who was transferred to Kandy from Horana in June. Mr. W. D. Banda was appointed as Instructor to the Horana Range as from June 17th. Mr. M. A. Pabilis, Rubber Instructor, Gampaha, resigned in September and was replaced by Mr. R. B. Heendeniya in November. Notice of resignation was also received from Mr. L. A. Peiris, Rubber Instructor, Matugama.

Each of the new officers appointed as Rubber Instructor was given a course of special training in rubber work before being sent to his range.

The work of the Smallholdings Department since its inception in 1936 was explained by the S. H. P. O. at a meeting of the Smallholdings Committee on July 7th to which members of the Board were invited. Members expressed satisfaction at the work being done and the propaganda methods adopted. It was suggested that acreages of holdings visited by Instructors and those found beyond redemption due to bad tapping and general neglect should be recorded, and arrangements were made accordingly in each range.

Normal advisory travelling was done by Instructors throughout the year except during June when the petrol strike curtailed the travelling of those who used motor vehicles. Five instructors possess small cars or motor cycles, while the other 5 travel by bicycle and bus.

Visits.

A total of 31 supervisory visits to ranges was paid in addition to advisory visits to individual small estates by request. Visits during November and December were made jointly with the Deputy Smallholdings Propaganda Officer to introduce him to the Instructors and initiate him to the work. The Director inspected the Matugama range on September 25th.

Sheetmaking and Smokehouses.

As the market price of rubber tended to come down with the progress of the year, special efforts were made to make smallholders realise that it was all the more necessary to improve the quality of their sheet. It was pointed out that, their cost of production being lower than that of the large estate owner, they could continue to produce sheet at a profit even when the large owner could not, and that this profit would be augmented by an improvement in quality. A drive was launched in all ranges with this end in view. Special arrangements were made with the Rubber Commissioner for instructions to be issued to all his Depots to:—

- (a) Avoid under-grading of smallholders' sheet brought for sale.
- (b) Pay intermediate prices for sheet which the Depot officer considered to be midway between the scheduled grades in quality.
- (c) Cut and return to the owner fractions of a pound that were not hitherto paid for at Depots.

Arrangements were also made to issue small "quality certificates" to small holders who made good sheet, which could be presented at the Depot when selling their sheet. These certificates were printed and will be issued during 1948 to smallholders who improve their sheet to at least grade 2 quality on the recommendations of this Department.

These steps have resulted in a number of positive cases being reported from all ranges where sheet has fetched 1 to 2 cents per pound more than they did before.

428 sheetmaking demonstrations were given by Instructors in 1947. The smoking of sheet in properly designed inexpensive wattle-and-daub smokehouses was encouraged by the construction of demonstration houses at suitable roadside holdings in all ranges. 22 such demonstration houses were started and 17 completed, part cost being defrayed by the Department. 55 houses similar to the demonstration houses were started by private owners under the Instructors' guidance and 30 completed. 61 existing houses were improved by the introduction of proper ventilation, etc., 1,216 visits to smokehouses were paid by Instructors in connection with the improvement of sheet. 173 square feet of mesh for strainers was sold at special rates to encourage the proper straining of latex.

The Chinese-made grooved roller imported from Malaya on trial some years ago was hired to a group of poor smallholders at Asideniya (in Kegalla district) on very easy terms in view of the interest shown by them in improving their sheet.

Two meetings were attended at Meegahatenne in connection with the formation of a Smallholders' Rubber Co-operative Society for making soft rubber. Although keen interest was shown at the start and costs of buildings, etc. were prepared, there was insufficient support to carry the scheme through.

The Hataraliadde Rubber Co-operative Society was continued to be visited twice a month by the Rubber Instructor, Kandy, and the Society functioned satisfactorily during the year with an increased membership.

New Planting.

57 field officers of the New Rubber Planting Scheme were given a course of training at Nivitigalakele in tapping, sheetmaking, diseases and clone-identification. The officers arrived in 3 batches in July, August and November. Each course was of a week's duration and consisted of talks by the S. H. P. O. followed by practical demonstrations and conducted tours round the clearings.

Advice to new-planting permit-holders was left more or less entirely to the staff of the New Planting Scheme but demonstrations in marking tappable holdings were given by Rubber Instructors upon request.

Replanting

The declining rubber market has not encouraged smallholders to undertake replanting to any appreciable extent but lining for contour holes and drains was done free by Instructors and other advice given whenever assistance in this connection was required. 633 replanted holdings were visited for advice and 591 tappable trees marked for purposes of demonstration.

There was a further increase in the yield of the demonstration replanted block at Baddegama (clone PB. 86), the average for the year being approximately 34 gms. per tree per tapping. 76 trees are being tapped. The block was planted with budded stumps in November 1938 and is in tapping since September, 1943. The 5 other demonstration blocks in the ranges were maintained in good order but further interest in the block at Ratmalgoda (Horana Range) was abandoned owing to complications that arose over a dispute in ownership, which made proper tapping and maintenance impossible.

Demonstrations

In addition to the demonstrations mentioned elsewhere, 39 budding, 266 tapping, 194 disease treatment and 220 miscellaneous demonstrations were conducted by Instructors.

Nurseries

10 demonstration nurseries were opened in the ranges for giving budding demonstrations and supplying small quantities of budded stumps to smallholders. Other nurseries opened in previous years were maintained and budded. 1,538 nursery plants were budded by Instructors and 320 budded stumps sold. 146 yards of budwood were issued for budding nurseries. 5 private nurseries were opened by smallholders with the Instructors' advice.

Compost Pits.

The simple process of collecting green loppings in a shallow pit and turning the heap at 10-14 days' intervals for making compost was popularised by the opening of demonstration compost pits in each range. A total of 47 demonstration and 26 privately-owned pits were opened. The compost made was given free to smallholders or used for manuring demonstration nurseries, replanted blocks, etc.

ESTATE DEPARTMENT

Darttonfield

Acreage Statement

		A.	R.	P.
Rubber: mature areas	...	101	1	28
Rubber replanted areas	...	55	3	22
Buildings and roads	...	16	3	08
Scrub, etc.	..	2	2	19
Newly acquired land	...	2	1	22
Total	...	179	0	19

Rainfall.—172.98 inches. Rainfall was above average. The South-West Monsoon rains burst unusually late in June and the August rainfall was the highest recorded for some years. A monthly summary is given on next page.

		1946	1947	5 years' average
January	...	1.66 ins.	12.45 ins.	7.15 ins.
February	...	7.84 "	6.02 "	6.54 "
March	...	9.93 "	15.40 "	12.26 "
April	...	20.25 "	7.16 "	12.20 "
May	...	7.46 "	13.92 "	22.66 "
June	...	13.48 "	25.04 "	19.24 "
July	...	8.59 "	12.27 "	8.79 "
August	...	14.79 "	24.04 "	12.72 "
September	...	11.62 "	12.86 "	13.54 "
October	...	20.65 "	26.39 "	25.07 "
November	...	17.04 "	8.65 "	16.88 "
December	...	24.67 "	8.78 "	12.98 "
Total	...	157.98 ins.	172.98 ins.	170.03 ins.

Crop.—The crop for the year was 67,875 lbs. which is 92.68 per cent of the estimated crop and 125 lbs. above that of 1946. The loss in crop is attributed partly to the replanting of 11 acres which was intensively tapped the previous year and partly to weather which was unfavourable to crop.

Yield records for individual fields are as follows:—

Field No.	Date of planting	Total crop lbs.	Acreage tapped	Yield per acre lbs.
1	1910	12,179	28½	427.3
2	1913	605	1	605.0
3	1917	10,744	24	447.6
4	1911	534	1½	427.2
5	1913	20,364	46½	437.9
6	1934	6,149	7½	793.4
7	1938	9,796	16½	602.8
8	1936	6,424	9½	676.2
9	1939	773	1½	618.4
10	1938	307	6½	47.2
		67,875	142½	476.3

Tapping.—The commercial areas were tapped on the 2S/2, d/4 system. Bark consumption 3½ inches on each cut. Upward cuts were opened on otherwise worthless trees. Tapping was discontinued on 21st February and resumed on 17th March. Tapping of the experimental areas was under the supervision of the Estate Superintendent. The Visiting Agent reported favourably on the standard of tapping in general.

The average daily intake per tapper was 6.5 lbs. compared with 6.6 lbs. in 1946. Average daily pay amounted to Rs. 1.46 including dearness allowance for tappers.

Manufacture.—Some sole crepe was manufactured after the middle of May. A summary of grades prepared during the year is given below :—

Grade	lbs.	Per cent	Total
Smoked Sheet No. 1	785	1.14	1.14
Sole Crepe „ 1	5,471	8.07	8.07
Latex Crepe „ 1	28,239	41.61	73.02
do „ 2	10,567	15.57	
do „ 3	10,753	15.84	
Scrap Crepe „ 1	6,056	8.92	17.38
do „ 2	3,520	5.19	
do „ 3	2,222	3.27	
Latex	262	.39	.39

Machinery.—The Consulting Engineers, Messrs. H. W. Hammond & Co., made their annual inspection of the machinery and electrical equipment on the 11th and 12th March. Their report was satisfactory.

The new piston and liner ordered in 1945 for the 20 B.H.P. Gardner oil engine was received and fitted in the course of the year. The 80-90 H.P. National engine and the new Nickle Battery as made by Nife Batteries Ltd. on order were not received by the end of the year.

An accident which occurred in December 1946 on the 26-inch water cooled grooved mill causing the cast iron keeps above the roller bearing blocks to crack, received attention and the keeps were renewed. The 26-in. water cooled smooth mill had the bearing journal on one of the rolls fractured in June. Messrs. Brown & Co. undertook the repairs. From June to October the mill was out of commission. A further breakdown occurred in December and the mill was again out of commission for a fortnight. While the mill was under repair the rubber was milled at Gallawatta and Pimbura estates. The breakdown of this mill adversely affected the percentage of sole crepe manufactured.

Buildings.—The construction of the following buildings was completed during the year :—

Secretary-Accountant's bungalow
 Junior Staff bungalow No. 12
 4 sets double roomed cottages
 2 sets double latrines.

Pests and Diseases

Oidium.—The incidence of oidium was not severe. One full and three partial rounds of sulphur dusting were carried out at 5 lbs. of sulphur per round per acre.

Phytophthora.—A severe secondary leaf-fall was experienced in July. In the 9½-acre clearing, the clone PB, 183 was adversely affected and recovery was very slow.

The following trees were uprooted in 1947 :—

Damage by wind	...	...	24
Building sites	...	...	12
Dry trees	...	...	15
Diseased trees	...	...	31
Total	...	...	<u>82</u>

Damage by fire over an area of 14 acres in the 1938 clearing occurred in February. The damaged trees were scraped and treated with fungicide. Failure to recover necessitated the removal of 9 trees.

Replanting.—The intensively tapped area of 11 acres where lining and holing was in progress by the end of 1946 was replanted in May, 1947. A clonal seedling trial was laid out according to experimental requirements. The following material was used :—

TJ. 1 (selfed), PB. 86 (illegitimate), PB. 5/139 (illegitimate) and GLS. 1 (illegitimate) from Dartonfield nursery.

H.P. seedlings and TJ. 1 budded stumps from Nivitigalakele nurseries.

Manuring.—The 1947 clearing of 11 acres received 4 ozs. saphos per tree and the 1941 clearing 6½ acres received R. 215 mixture. The mature areas were manured according to programme.

Cover Crops.—The planting of *Desmodium ovalifolium* was continued. It was suggested by the Visiting Agent that it would be desirable to plant the cuttings closer.

Weeding.—Grass was eradicated. Rubber seedlings and indigenous erect covers were lopped. An extensive weeding programme started in September was satisfactorily completed by December.

Forestry Area.—This area was manured according to experimental requirements. Natural covers causing obstruction to the movement of tappers was eliminated.

Labour.—Labour was sufficient and appeared more settled towards the end of the year. Details of labour on check-roll at the end of the year were as follows :—

	Residents	Non-residents
Ceylonese	18	53
Non-Ceylonese	65	
Average daily out-turn	109	
Average daily pay	1.46	
(including dearness allowance)		

Health.—Record of sickness among staff and labour force :—

Malaria	...	...	99 cases
Ulcers	...	...	92 "
Influenza	...	...	195 "
Worms	...	...	128 "
Anchylostomiasis	...	...	36 "
Miscellaneous and minor ailments	...	...	622 "

Visiting Agent.—The Visiting Agent, Mr. W. A. Paterson, inspected the estates once during the year and reported favourably on their condition.

Nivitigalakele Acreage Statement

Rubber mature areas (1926-1935)	...	68½ acres
Clearings (1939-1944)	...	46½ "
Repanted area — 1946	...	21 "
Nurseries and roads	...	17 "
Uncultivated	...	16 "
Total		<u>169½ acres</u>

Rainfall.—146.5 ins.

Crop.—The crop secured for the year was 53,961 lbs. This is 5,961 lbs. above the estimate and 14,407 lbs. above 1946. The 1941 clearing — 7 acres — was brought into tapping during the year. The older fields in commercial tapping continued to give improved yields. The following is a summary of yield records for each field :—

Clearing		Acreage in tapping	Crop lbs.	Yield per acre lbs.
1926 clearing	...	13½	12,870	936.0
1927	„	10½	8,442	785.3
1928	„	16	10,025	626.5
1935	„	28½	16,141	566.4
1939	„	10½	3,699	360.8
1940	„	9½	1,926	197.5
1941	„	5	858	171.6
		94	53,961	574.1

Tapping.—The commercial areas were tapped on double 4. Bark consumption 3½-in. on each cut. Test-tapping was on S/2 d/2 system. Tapping was discontinued on the 21st February and resumed on the 17th March. The Visiting Agent commented favourably on the tapping, but recommended that the older clearings should be reverted to the double 3 system.

Average daily intake per tapper was 9.3 lbs. compared with 8.6 lbs. in 1946; and the daily pay for tappers amounted to Rs. 1.56 (including dear-ness allowance).

Manufacture.—One third of the crop was manufactured in the form of smoked sheet at Nivitigalakele factory in the months of January, April, September and October, 1947. The rest of the coagulum was sent to Dartonfield for manufacturing sole crepe and other grades.

The distribution of grades is as follows :—

Grade		lbs.	Per cent	Total
Smoked Sheet No. 1	...	7,080	13.12	13.12
Sole crepe	„ 1	3,650	6.76	6.76
Latex crepe	„ 1	15,568	28.85	57.22
Latex crepe	„ 3	6,160	11.42	
Latex crepe	„ 3	9,145	16.95	
Scrap crepe	„ 1	6,579	12.38	22.90
Scrap crepe	„ 2	3,946	7.31	
Scrap crepe	„ 3	1,833	3.21	

Machinery.—The 5 H.P. National engine was decarbonised.

Buildings.—Lines. 2 double roomed cottages were built.

Pests and Diseases.

Oidium.—The late wintering trees were severely attacked. A full round of sulphur dusting and two partial rounds were done. 5 lbs. of sulphur per acre per full round and 3 lbs. per acre were used for the two partial rounds.

Phytophthora.—Older clearings were attacked badly in July.

Bark Rot.—A few cases of bark rot were noticed in the areas in tapping. The usual methods of control were adopted.

A summary of trees uprooted in 1947 is given below:—

Wind damage	...	...	2
Ustulina	...	...	2
Building site and telephone	...	...	17
Fomes	...	...	9
Total	...	...	<u>30</u>

32 trees in the 1926 and 1928 clearings were damaged by fire. These were scraped and treated with fungicide.

Canker Scraping.—This was done in the 1939, 1940 and 1942 clearings.

Manuring.—The 1947 manuring programme was completed.

Nurseries.—Budwood nurseries were manured and pruned according to requirements.

Seedling Nurseries.—Backward seedlings were manured with 12 ozs. compost and $\frac{1}{2}$ -oz. R. 215 mixture per plant.

Hand-pollinated Seedling Nurseries.—The disposal of material from these nurseries was as follows:—

1944 Hand-pollinated Seedlings.—235 H.P. seedlings were planted in the 1946 (16 acres) clearing at Hedigalla in May 1947.

2,356 budded stumps representing the clones derived from the 1944 H.P. seedlings were planted (in 5-tree plots of 2 per hole) in the 1947 60-acre clearing at Hedigalla in October, 1947.

1945 Hand-pollinated Seedlings.—3,565 H.P. seedlings were planted in the 1947 60-acre clearing at Hedigalla in October, 1947. The remaining 1,200 seedlings were distributed to nine outside estates. Clones derived from these latter seedlings were planted in 5 tree plots by the estates concerned in clearings adjacent to the seedling plantations.

Labour.—Labour for all works was sufficient except during the harvesting periods. Details of labour on the checkroll at the end of the year were as follows:—

		Resident	Non-resident
Ceylonese	...	28	59
Non-Ceylonese	...	1	—
Average daily out-turn			72
Average daily pay			1.43

(including dearness allowance)

Hedigalla Estate.

Acreage Statement

1943 Clearing	...	...	11 acres
1944 ,	...	...	14 "
1945 ,	...	...	25 "
1946 ,	...	...	16 "
1947 ,	...	...	60 "
Total	...	...	<u>126 acres</u>

1947 Clearing — 60 acres.—The felling and burning operations of 40 acres of this clearing were completed by the middle of March. Lining and holing according to experimental requirements were carried out. The distance of planting was 40 feet by 8 feet square planting, the rows running east to west. A further 20 acres was cleared felled and burnt. Lining and holing of this area was also done. A total of 5,474 holes were planted with 1945 H.P. seedlings and derived clones.

Immature Areas.—Growth was satisfactory.

Manuring.—The young areas were manured according to programme.

Green Manure.—Cuttings of *Desmodium ovalifolium* were planted out and are spreading well.

Buildings.—The following buildings were completed during the year :—

Two sets of double room lines

Two latrines.

The following are under construction :—

One junior staff bungalow

Two sets of double room cottages.

Cart Road.—The 4th half mile was completed in March. The road was very badly churned up on many occasions. Earlier in the year the colonists used bullock carts on this road for the transport of timber and firewood and latterly heavy lorry traffic was resorted to with the resultant serious damage to the road. Surface repairs were attended to monthly.

Food Production

Areas under cultivation for food crops were as follows :—

Nivitigalakele	...	...	½ acre
Hedigalla	...	...	35 acres

Crops harvested during the year :—

Paddy	...	...	200 meas.
• Manioc	...	...	2,618 lbs.
Pineapples	...	...	1,365 fruits

Advisory Services, etc.

The annual summary is as under :—

			Estate
		Enquiries	Visits
Chemical Department	...	272	15
Botanical and Mycological Department	...	331	12
Soils Department :—			
General	...	85	—
Fertiliser Rationing	...	194	12

In the Chemical Department the weight of enquiry was fifty per cent greater than that of 1946 and concerned mainly methods of procedure and machinery for the manufacture of sole crepe, defects in sole crepe and the preservation and concentration of latex.

In the Soils Department the number of enquiries was about the same as in previous years and concerned mainly fertiliser rationing.

In the Botanical-Mycological Department incoming enquiries also showed an increase of over fifty per cent over 1946. The poisoning of rubber trees for replanting was a new item upon which a number of enquiries were made.

Two new advisory circulars were issued. Particulars of these appear under "Publications."

Meetings, Committees, etc.

The Director attended by invitation all meetings of the Board of Management, and served on the Experimental Committee, the Smallholdings Committee, the Senior and Junior Staff Salaries Committees and the Financial Sub-Committee.

The Soil Chemist represented the Scheme at meetings of the Fertiliser Rationing Committee.

The Director represented the Scheme at the Annual General Meeting of the Planters' Association of Ceylon and at various meetings of the Kalutara Planters' Association in company with other officers. The Director and Mycologist attended meetings of the Matale and Kandy Planters' Associations.

The Director attended several meetings in Colombo at the request of the Special Rubber Commissioners during their enquiry into the state of the Rubber Industry and prior to the publication of the "Report of the Commission on the Rubber Industry in Ceylon." The Chemist and the Smallholdings Propaganda Officer also responded to special calls.

Co-operation with other Research Associations.

The long standing co-operation with the London Advisory Committee for Rubber Research (Ceylon and Malaya) was actively maintained. A Botanist appointed by their good offices became ill and withdrew just before sailing and the financial arrangements consequent upon the withdrawal were concluded very satisfactorily by the Committee.

The fullest exchange of views has taken place on many subjects with the Rubber Research Institute of Malaya now happily restored to an active state.

The British Rubber Producers' Research Association has continued to assist us wherever possible and Dr. G. Gee, its Director, spent several days in Ceylon towards the end of the year during which time he was able to visit the Scheme's laboratories and estates, to see some of the Island's rubber in company with Director, R. R. S., and to discuss with him the probable future of rubber research in the various rubber producing territories.

Correspondence has also passed between the Scheme and the Research Association of British Rubber Manufacturers.

In the matter of enquiries into the commercial possibilities of rubber seed oil, very active help was given to the Scheme by the Coconut Research Scheme, and close co-operation with the Tea Research Institute on matters concerned with fertiliser rationing was maintained.

Publications were exchanged with research organisations in many parts of the world.

Publications

Publications of the Research Scheme are issued without charge to the Proprietors (resident in Ceylon), Superintendents and local Agents of Rubber estates over 10 acres in extent, who apply for registration. Extra copies are supplied for the use of Assistants on large estates. Particulars of issues of publications are given below :—

		1946	1947
Estates and Agencies	...	959	972
Subscribers	...	51	53
Exchange List	...	65	65

Publications issued during the year were as follows :—

Report of the work of the Rubber Research Board in 1946.

Combined 1st and 2nd Quarterly Circulars for 1947.

Advisory Circular No. 17—Tapping Systems for Young Rubber
(Revised March, 1947).

do. No. 26—Clonal Seed as Planting Material (July
1947).

(Sgd.) EDGAR RHODES,
Director.

Research Laboratories,
Dartonfield, Agalawatta,
2nd April, 1948.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA) FOR 1947

RUBBER DEPARTMENT

General Administration

As indicated last year the temporary arrangement made during the war under which the Imperial Institute and the Rubber Research Scheme of Ceylon shared the cost of the work carried out under the direction of the Committee, ceased at the end of 1946. With effect from 1st January, 1947, the Boards of the rubber research organisations in Ceylon and Malaya agreed to share in the same proportion as pre-war years the financial contribution for the Committee's research and agency work.

The Committee and Technical Sub-Committee held three meetings during the year and in addition the Selection Sub-Committee met on several occasions to deal with replies to advertisements issued with a view to filling the vacancies in the European Staff in the East. Many of these vacancies have existed since the end of the war, but were still unfilled at the end of the year in spite of the most extensive enquiries. The Committee were, however, successful in filling two posts in each of the Chemical and Pathological Divisions and one in the Botanical Division of the Rubber Research Institute of Malaya,

Preliminary courses of training for selected candidates were arranged in the Committee's laboratories and those of other scientific organisations in this country. For one of the vacancies in the Chemical Division a scholarship has been awarded to a young graduate who is being trained at the Imperial Institute, with a view to taking up duty in Malaya at the end of 1948.

The Rubber Research Institute of Malaya suffered serious loss owing to the resignations of Mr. J. D. Hastings, Head of the Chemical Division, and Mr. J. H. Pidford, Chemical Engineer, to take up more remunerative employment offered by commercial organisations in Malaya.

At the suggestion of the Committee, salary scales at the Rubber Research Institute have been improved, which it is hoped will result in attracting more and better qualified candidates, and place the Institute in a better position to retain the services of experienced officers.

On the recommendation of the Committee the Malayan Government appointed Mr. C. E. T. Mann, the Head of the Botanical Division of the Rubber Research Institute, to become Director of the Institute, in succession to Mr. H. J. Page who resigned to accept the position of Principal of the Imperial College of Tropical Agriculture, Trinidad. Dr. E. Rhodes, of the British Rubber Producers' Research Association, formerly Head of the Chemical Division of the Rubber Research Institute, was appointed by the Board of the Ceylon Rubber Research Scheme as Director *vice* Mr. T. E. H. O'Brien, who had been compelled to retire on account of ill-health. The vacant post as Head of the Chemical Division of the Rubber Research Institute was offered to and accepted by Mr. M. W. Philpott, Chemist to the Ceylon Rubber Research Scheme.

With a view to assisting the Rubber Research Institute in the serious difficulties which have arisen owing to the absence of experienced staff in the Chemical Division, arrangements have been made for a senior member of the staff in London, Mr. H. C. Baker, to be seconded for service in Malaya for a period of one to two years.

Since 1939 methods employed at the Imperial Institute for determining the quality of rubber have been modified considerably as a consequence of the experience gained by manufacturers during the War with African Wild Rubbers and with synthetic materials. Mr. Baker's experiences in these developments will be utilised in making similar modifications in the methods of physical testing employed in Malaya.

Packing of Rubber

It was suggested by a large English rubber manufacturing concern last year that natural rubber should be packed in 75 lb. bales similar to the standard package of GRS synthetic rubber. Among the advantages claimed for this bale, as compared with the standard 2 cwt. cubical bale were reduction of distortion and greater ease of handling and stacking on arrival in the country of manufacture. After consultation with other manufacturers it was decided to ask the Rubber Research Institute of Malaya to arrange for the preparation of a trial consignment of 20 tons packed in bales of 75 lb. This consignment arrived during the year and was distributed by the Federation of British Rubber Manufacturers' Associations to manufacturers in the U. K. for their opinion. A conference was held in September with representatives of the Federation, the Rubber Trade

Association and Wharfingers to consider the reports received. The 75 lb. bale was strongly favoured by all classes of manufacturers, but it would cost more to pack in the East and handling charges in transit might be increased.

The representatives of the R. T. A. pointed out that it would not be practicable to pack in small bales for the U. K. and in larger bales for the U. S. A., and it was agreed that little or no progress would be made unless American manufacturers also preferred the small bale. It was accordingly decided to inform the Rubber Manufacturers' Association of America, of the opinions received from British manufacturers and to ask the Association whether they would be willing to arrange for tests with a consignment of from 500-1,000 tons to ascertain the preference of American manufacturers. It is understood that some of the very large firms equipped with large size Banbury mixers able to deal with a bale of 224 lb. without cutting have previously not favoured the idea of a smaller bale.

RESEARCH

1. Properties of Dry Rubber

Chief attention this year has been given to a continuation of the study of the resilience of natural rubber. Resilience may be regarded as a measure of elasticity and is of considerable importance in determining the suitability of rubber for tyres and other important uses. The more resilient the rubber the less is the amount of heat developed in a tyre running at speed, and other factors being equal the cooler the rubber the more resistant is the tyre to internal breakdown such as "heat blow-out" tread separation and ply looseness. Natural rubber is already superior in resilience to all synthetic rubbers, and the object of the work is to increase this important advantage.

It was reported last year that thorough purification of Hevea rubber leads to an improvement in resilience. This has now been confirmed and it has been shewn that the improvement is significant and would be of practical importance if highly purified rubber could be prepared economically. Purification not only involves special treatment of latex to remove protein and water-soluble impurities, but also extraction with acetone or alcohol to remove others. The total yield of rubber is thereby decreased by over 5 per cent so that, apart from cost of treatment, there must be a 5 per cent increase in price to compensate for loss of yield. Moreover, it is necessary to take precautions to avoid rapid deterioration which occurs when highly purified rubber is kept under normal conditions. In the circumstances, the results given by purified rubber are only of practical value in so far as they are a guide to the preparation of good quality material.

Having established the importance of purification, an attempt has been made to determine whether the results given by rubber hydrocarbon from various botanical sources are the same. A start was made with commercial unpurified Funtumia sheet and Landolphia vine rubber from Africa in comparison with Hevea smoked sheet. The wild rubbers gave resilience results intermediate between those of Hevea and general purpose synthetic rubber. The fact that the wild African rubbers are inferior to plantation Hevea may be due to the impurities which they contain, but partial purification by acetone extraction did not effect an appreciable improvement. Moreover, extracted Landolphia contains approximately the same percent-

age of rubber hydrocarbon as commercial Hevea smoked sheet. Although Hevea rubber is superior to wild rubbers it is not suggested that there is a fundamental difference in the chemical structure of the rubber hydrocarbons. Molecular weight distributions and state of oxidation affecting molecular cohesions are more likely causes of the difference observed. It is hoped to study these problems in 1948.

The possibility of the existence of rubber hydrocarbons of different technical qualities was further examined by dividing highly purified rubber into a series of fractions depending upon ease of solution in organic solvents. It was found that the least soluble fractions gave the best results. The insolubility of the fraction may be partly due to molecular size and also the fact that the rubber behaves as if the molecules were lightly cross-linked (elasticity, insolubility and lack of "tack.") It is not known why a small amount of molecular bridging should produce a better rubber, but if it is true of all gel or relatively insoluble rubber, the preparation on estates of artificial gel should not be too difficult.

As highly purified rubber and its fractions are somewhat of a scientific curiosity the vulcanising and mechanical properties were studied in some detail in a range of mixes. In a tyre-tread mix and the corresponding mix without carbon-black the fractions all gave results superior to those given by smoked sheet when the fatty acid content of the mixes was suitably adjusted. In the rubber-sulphur mix, however, it was very difficult to obtain reasonably satisfactory mechanical properties, particularly in the case of the most soluble fraction. In fact this fraction hardly vulcanised physically, although the rate of combination of rubber and sulphur was not abnormal. The absence of physical effect may be due to oxidation during vulcanisation or to the possibility that a trace of accelerator is essential for molecular cross-linking through sulphur.

The opportunity was also taken to shew that carbon-black reinforces a highly purified rubber sulphur mix, and that except as an aid to vulcanisation in the presence of zinc oxide, fatty acids are harmful to the finished product, irrespective of whether carbon-black is present or not.

In addition to the main investigation on the properties of highly purified rubber, it has been necessary to make complementary investigations on subsidiary issues. For instance, the method of preparing the dry rubber from purified latex appeared to have an effect on the properties of the vulcanised material but the differences were eventually shewn to be related to traces of impurities still retained in the rubber.

The rapid oxidation of purified rubber is a danger which has to be guarded against because of its possible effects on the results of quality tests. The deliberate marked oxidation of smoked sheet led to inferior results, so that if purified rubber is markedly oxidised during mastication and vulcanisation, it should give still better results if oxidation could be prevented. The easiest method of preventing oxidation is to add an anti-oxidant, but it is difficult to find one which is otherwise inert. Anti-oxidants generally have some hardening, softening or vulcanisation accelerating effect. Of those tried pyrogallol appears to be the most promising. There is no direct evidence of marked oxidation but it might explain the difficulty of vulcanising the easily soluble fraction of purified rubber in a rubber-sulphur mix and the fact that the experimental error associated with the results of mechanical tests is higher for purified rubber than for commercial smoked sheet. A marked improvement in the vulcanisation

of the rubber-sulphur mix was obtained in the presence of pyrogallol but this may have been due to the effect of pyrogallol on the course of the reaction between rubber and sulphur. The only conclusive experiment is the rather difficult one of vulcanising the rubber in the complete absence of air. This may be tried in 1948.

The study of highly purified rubber is still proceeding, and even if there is no possibility of preparing such material commercially the experiments indicate the lines along which an improved method of preparation should be sought. They also indicate that within the limits of the basic molecular structure, there are reasonable possibilities of obtaining rubber hydrocarbon of improved industrial value.

One method of achieving this would be to study the variation in the hydrocarbons synthesised by a wide range of seedling trees and using the best as mother trees for producing vegetative offspring. Plans have been made to carry out such an investigation in Malaya during 1948. The development of new clones solely on account of the quality of the hydrocarbon is of course an extremely long range undertaking and unless the improvement in quality were of outstanding practical importance it would need to be brought into association with the characteristic of high yield of latex by the tree to be of economic interest to growers of plantation rubber. In the meantime a study is in progress at the Imperial Institute of the rubber hydrocarbons from each of a number of well-known Malayan clones likely to be recommended for planting on a large scale owing to their high-yielding and other favourable characteristics.

2. Gelling and Peptising Agents.

The most likely causes of variation in rubber hydrocarbons are differences in molecular size distributions and molecular cohesions. Once the latex has left the tree an increase in unbranched chain length is only a remote possibility, but an alteration in molecular cohesion is more easily achieved. Even treatment of latex with ammonia appears to have such an effect. It is not certain that either increased chain length or molecular cohesion would be of importance in the masticated and vulcanised product, but the limited experience available indicates that differences in the unvulcanised hydrocarbon are sometimes reflected in the vulcanised material.

A study of the treatment of latex with a range of substances likely to affect molecular cohesions and linkages has confirmed that a *m*-phenylenediamine is one of the most effective "hardening" agents known, that the *p*-isomer is somewhat less effective and that the *p*-isomer has a tendency to soften rubber. An attempt to relate the effect of various substances to the oxidation-reduction potentials of each system was only partly successful. These potentials can be strictly defined in the case of thermodynamically reversible systems, but at the best are only a rough guide to the oxidising tendency of the non-reversible systems employed in these experiments.

Whether the hardening or softening of rubber is wholly a question of oxidation or whether other factors are involved is not known. Preliminary investigations indicate that treatment of rubber with mercaptobenzthiazole requires less oxygen for a given amount of softening than heating rubber in air and that the hardening produced by *m*-phenylenediamine requires very little oxygen, if any. Moreover, an oxygen absorbing material such as pyrogallol prevents softening of rubber heated in air or

treated with a peptising agent, but has no effect on mastication which is also stated to be an oxidation phenomenon. The rheological properties of rubber softened by mastication are also different from those of rubber softened by peptising agents. On the whole, these investigations have merely served to emphasize the complexity of the problem and the need for a more systematic and fundamental approach to its study. This is being planned for 1948.

One of the most puzzling hardening agents so far examined is a mercury-aluminium couple in association with latex or unmachined wet coagulum. The hardening produced does not appear to be passed on to the vulcanised product and is therefore only of practical value for such purposes as the preparation of toughened sole crepe. Other hydrogen producing materials are not found to be hardening agents.

3. Development Work

The pilot plant which is being erected at the Imperial Institute for the preparation of dry rubber by a continuous process is now taking practical form in spite of long delays, due to difficulties in obtaining materials and of finding time to devote to mechanical details. The coagulation and washing side of the process is fairly satisfactory, but details of the arrangements for drying have not yet been completely worked out and tried. Much has been learned about the technique of manipulating thin, stretchy, adhesive films, and simple devices have been installed to ensure reliable and continuous service. It was hoped to complete the work in this country during 1947, but it is now expected that the work will continue throughout 1948 after which the plant will be dismantled and shipped to Malaya for trial with fresh latex.

The object of the process is not merely to effect a small reduction in cost as compared with smoked sheet but also to prepare a cleaner and more reliable rubber which cannot be confused with smoked sheet which is graded on appearance only and may or may not have come from a reliable source.

4. Latex

The practical importance of the various naturally occurring non-rubber substances in the preservation and utilisation of latex is being gradually established. Fairly detailed information has already been obtained about nitrogenous compounds and more attention is now being given to compounds of phosphorus. It is known that lecithin — a compound containing phosphorus — is present in fresh latex and is a surface active material likely to be of importance in stabilisation. Attempts were made therefore to ascertain how much phosphorus is associated with the rubber particles in preserved latex. Appreciable amounts of magnesium ammonium phosphate are precipitated in the insoluble sludge formed in freshly preserved latex, but after removal of the sludge the latex still contains phosphorus as a major non-rubber constituent. Distribution experiments have now shewn that the phosphorus is mostly in the serum or water-phase and that it is not appreciably associated with the rubber. Occasional irregular results have been obtained suggesting that some phosphorus was associated with the rubber-phase but it is believed that this is due to the mechanical entanglement of colloidal insoluble phosphorus compounds. Even in latex preserved wholly with sodium pentachlorophenate, which would have less tendency than ammonia to hydrolyse lecithin, there was

no evidence that phosphorus was associated with the rubber-phase. It is of interest that the phosphorus in dried latex films could not be extracted with water, dilute acid or alcohol. It is possible therefore that by the time latex reaches the U. K. or U. S. A., the whole of the phosphorus is present in an insoluble form, distributed in the aqueous phase with a tendency to become entangled with the rubber particle. One of the practical implications of this suggestion is that phosphorus compounds are not likely to be responsible for difficulties experienced when latex is compounded with zinc oxide.

A preliminary examination of latex for potassium compounds suggested that they were mostly in the water-phase in ammonia-preserved latex and that a larger amount was associated with the rubber in latex preserved with sodium pentachlorophenate.

A fairly detailed examination of latex with different preservatives confirms that ammonia causes the decomposition of surface-active nitrogenous compounds and that the products pass into the aqueous phase, which as usual contains relatively large quantities of water-soluble acids as compared with latex preserved with sodium pentachlorophenate.

It has been shown in previous reports that when a potassium soap is added to latex almost the whole of the surface nitrogenous material is displaced and passes into the aqueous phase. It has now been found that sterols are also displaced. This is the first direct evidence which has been obtained that sterols are at the surface of the rubber particles, although it is well known that sterol-protein complexes form mechanically stable, surface active films.

The evidence indicates so far that the rubber particles in preserved latex are protected from coagulation by a complex film containing protein which is slowly being hydrolysed but is part of a complex film containing sterol and fatty acids both of which remain fairly constant.

A range of substances was tested for their capacity to replace nitrogenous materials, from the surface of rubber particles. The unsaturated soaps previously used tend to form peroxides which may have an adverse effect on the quality of the rubber. Of the materials tried the most effective at room temperature was sodium laurate, and as a result ammonium laurate is now being used in the preparation of highly purified rubber.

Co-operation

Details of co-operation with the British Rubber Producers' Research Association, the Research Association of British Rubber Manufacturers, the Institution of the Rubber Industry and the British Standards Institution were given in last year's report. This co-operation has been maintained and is proving helpful to the work of the staff and is believed to be of value to workers in the East.

ESTIMATES FOR 1948

(Adopted by the Board, November 3rd, 1947.)

INCOME

				Rs.
1. Cess Collections	...	...	...	420,000
2. Interest	...	...	...	14,400
3. Sale of Publications	...	...	...	800
4. Profit from Dartonfield	...	...	...	10,603
5. Profit from Nivitigalakele	...	...	(Loss)	6,041
6. Sundry Receipts	...	...	...	1,650
				<u>Rs. 441,412</u>

REVENUE EXPENDITURE

			Rs.	Rs.
1.	Administration of the Board :—			
	Travelling Expenses of Board Members			3,500
2.	Personal Emoluments :—			
	Senior Scientific Staff	... ..	106,330	
	Junior Scientific Staff	... ..	22,995	129,325
3.	Library and Publications :—			
	Library	... ..	1,500	
	Publications	... ..	3,500	5,000
4.	Smallholdings Department :—			
	Salaries and Allowances	... ..	31,411	
	Travelling and General Expenses	... ..	18,770	50,181
5.	Laboratory :—			
	Equipment and Working Expenses	... ..	6,000	
	Furniture Replacements	... ..	50	6,050
6.	Field and Factory Experiments :—			
	Field Experiments	... ..	5,710	
	Factory Experiments	... ..	3,823	9,533
7.	Office :—			
	Salaries of Office Staff	... ..	17,690	
	Stationery and Office Equipment	... ..	3,500	
	Postage and Telegrams	... ..	3,000	
	Advertising	... ..	500	
	Telephone	... ..	1,200	
	Audit	... ..	900	26,790
8.	Travelling Expenses of Staff :—			
	Officers' Expenses	... ..		7,000
9.	Maintenance of Buildings, Water and Power Supply :—			
	General Buildings	... ..	500	
	Bungalows	... ..	5,000	
	Water and Power Supply	... ..	3,000	
	Furniture Replacements	... ..	500	9,000
10.	Miscellaneous Items shared with Estates :—			
	Dartonfield General Charges	... ..	28,920	
	Nivitigalakele General Charges	... ..	14,216	
	Hedigalla General Charges	... ..	12,706	
	Upkeep of Roads and Grounds	... ..	1,125	
	Factory Upkeep	... ..	1,650	
	Power Supply	... ..	9,682	68,293
			Carried over	Rs. 314,678

		Rs.	Rs.
	Brought forward	Rs. 314,678	
11. Contingencies :—			
Contributions to London Advisory Committee		27,000	
General Charges	...	1,000	
Insurance Charges	...	5,300	
Staff Provident Fund	...	29,000	
Passages	...	15,000	
Entertainment Allowance	...	150	
War Allowance to Staff	...	51,700	
Special Allowance to Junior Staff	...	4,950	
Contribution to Medical Fund	...	2,100	136,200
12. Depreciation	...		27,000
13. Planting Food Crops at Hedigalla	...		750
			<u>Rs. 478,628</u>

CAPITAL EXPENDITURE

Buildings :—

Dartonfield :—

2 double cottages	...	8,000	8,000
-------------------	-----	-------	-------

Hedigalla :—

2 double cottages	...	8,000	
Coagulating shed and store	...	4,000	
1 set of double latrines	...	260	12,260

Equipment :—

Nivitigalakele :—

1 pair smooth hand rollers	...	1,500	
1 coagulating tank	...	500	2,000

Immature Areas :—

Dartonfield	...	1,871	
Nivitigalakele	...	3,769	
Hedigalla	...	17,095	22,735

Cart Road :

Hedigalla — Extension $\frac{1}{2}$ -mile	...	7,500	
	...	<u>Rs. 52,495</u>	

SUMMARY

Income	...		441,412
Expenditure :—			
Revenue	...	478,628	
Capital	...	52,495	531,123
Excess of Expenditure over Income	...		<u>Rs. 89,711</u>

PRINTERS:

H. W. CAVE & CO., LTD.

COLOMBO.
